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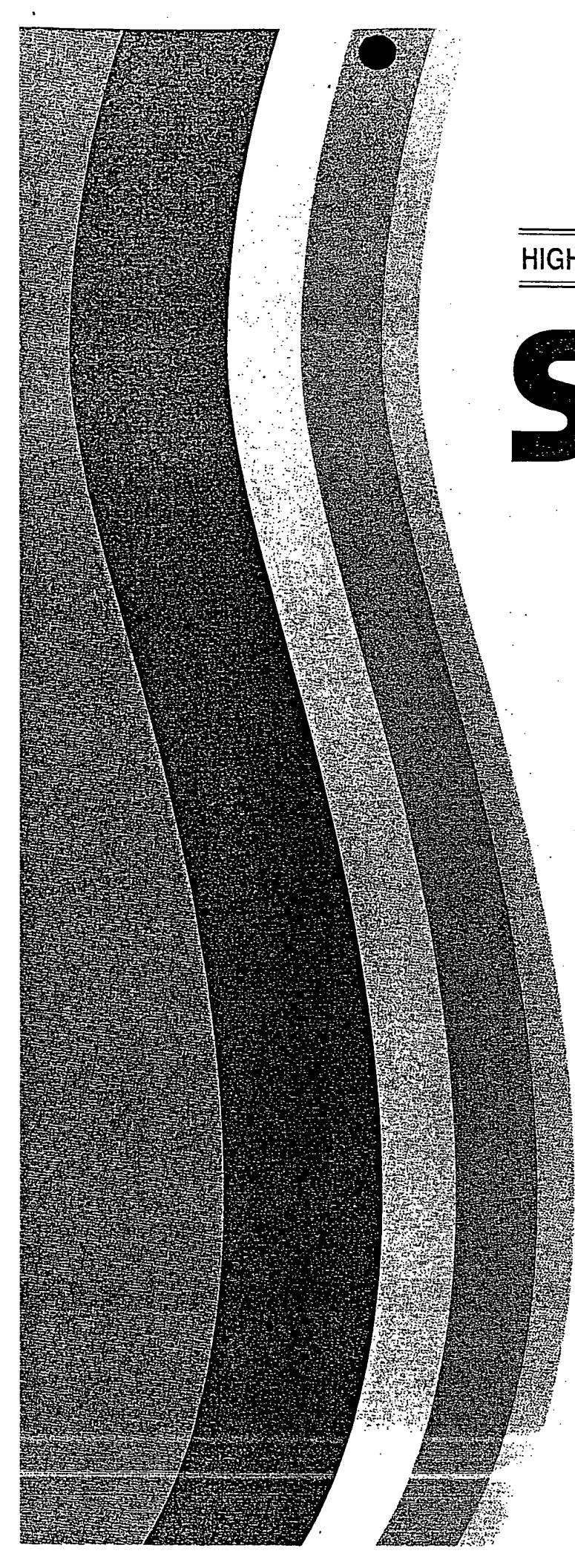
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HIGH PERFORMANCE THERMOPLASTIC RUBBER

SEPTON®



KURARAY

KURARAY CO., LTD.
SEPTON Company of America
KURARAY EUROPE GMBH

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What is SEPTON® ?

Unique and Versatile Polymer

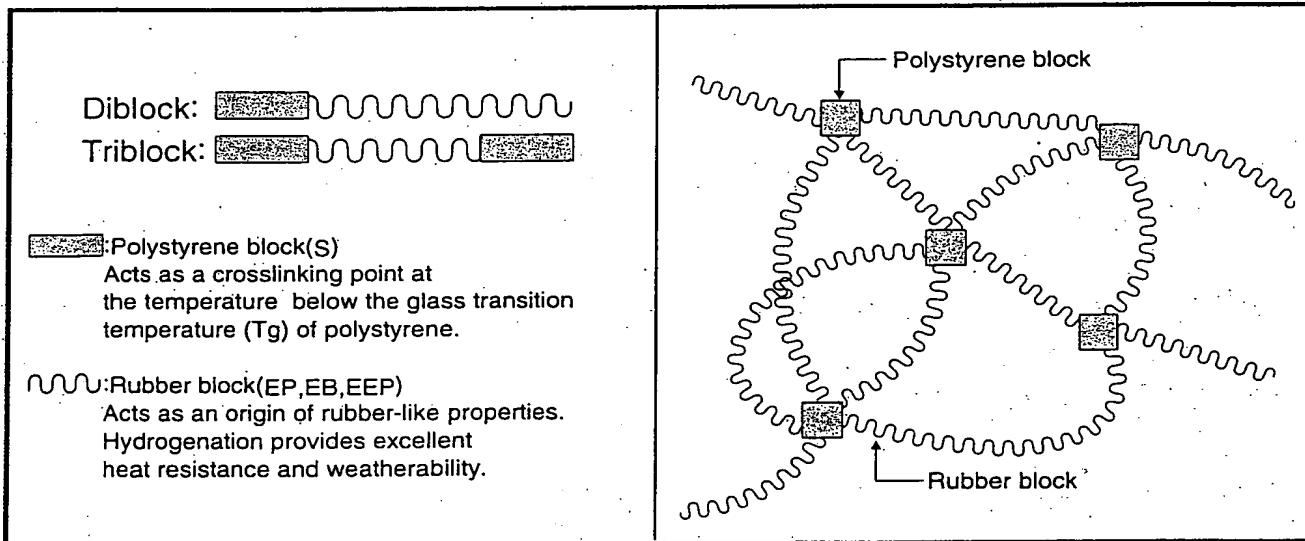
SEPTON® is a series of high performance thermoplastic rubbers developed by KURARAY CO., LTD. using its unique isoprene technology.

In terms of structure, SEPTON® is a series of hydrogenated styrenic block copolymers, and it exhibits rubber-like properties over a wide range of temperatures. Its remarkable characteristics are as follows:

- Excellent Mechanical Properties
- Good Weatherability
- Excellent Low Temperature Properties
- Excellent Electrical Insulation Properties
- Superior Heat Resistance
- Excellent Chemical Resistance
- Low Toxicity

Prior to processing, the polystyrene end blocks are associated in rigid domains. In the presence of heat and shear such as during processing, the polystyrene domains soften and permits flow. After cooling, the polystyrene domains reform and harden, locking the rubber network in place. This physical phenomenon provides SEPTON® with its high tensile strength and its elasticity. Since SEPTON® is a thermoplastic, it is recyclable.

Molecular Structure Model





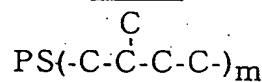
SEPTON®

Types and Properties

SEPTON® is available in either a diblock (A-B) type^{*1} or the more common triblock (A-B-A) types.^{*2, *3, *4}

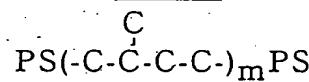
Several types of hydrogenated styrenic block copolymers of SEPTON are a hydrogenated poly(styrene-b-isoprene) (SEP)^{*1}, a hydrogenated poly(styrene-b-isoprene-b-styrene) (SEPS)^{*2}, a hydrogenated poly(styrene-b-butadiene-b-styrene) (SEBS)^{*3} and a hydrogenated poly(styrene-b-isoprene/butadiene-b-styrene) (SEEPS)^{*4}. Each type of polymers has its own set of unique properties.

SEP^{*1}



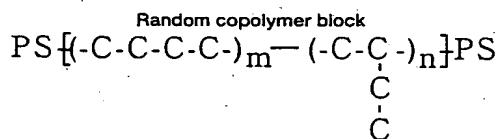
- Good Flowability

SEPS^{*2}



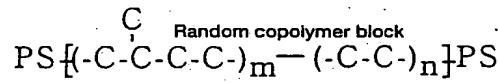
- No Crystallization
- Better Low Temperature Properties
- High Elongation

SEBS^{*3}



- Moderate Tensile Strength

SEEPS^{*4}



- High Tensile Strength
- Moderate Elongation
- Better Oil Absorbency

^{*1} Polystyrene-b-poly(ethylene-propylene)

^{*2} Polystyrene-b-poly(ethylene-propylene)-b-polystyrene

^{*3} Polystyrene-b-poly(ethylene-butylene)-b-polystyrene

^{*4} Polystyrene-b-poly(ethylene-ethylene-propylene)-b-polystyrene



SEPTON®

High Performance Thermoplastic Rubber

SEPTON® is offered in a variety of grades as shown below:

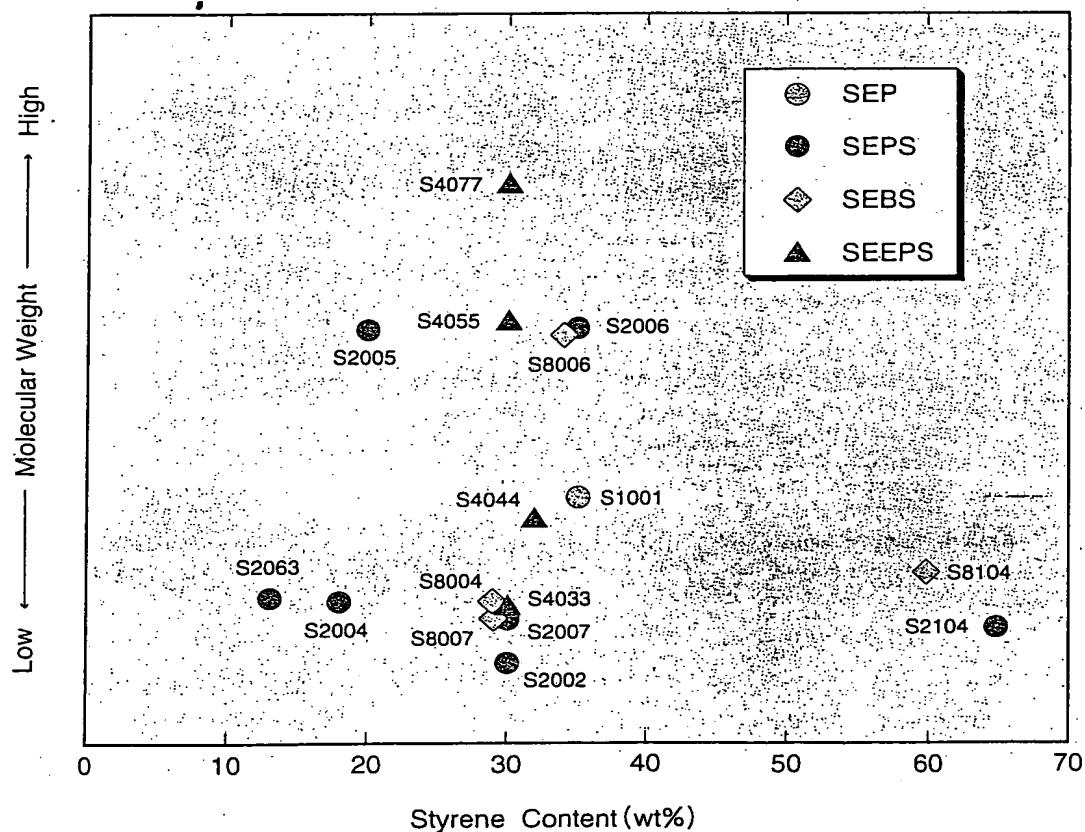
SEP : Polystyrene-b-poly(ethylene/propylene)

SEPS : Polystyrene-b-poly(ethylene/propylene)-b-polystyrene

SEBS : Polystyrene-b-poly(ethylene/butylene)-b-polystyrene

SEEPS : Polystyrene-b-poly(ethylene/ethylene/propylene)-b-polystyrene

SEPTON® Grade Map





An Aid in Selecting the Right SEPTON® Grade for Your Application

The following pages are intended to assist in the selection of the proper SEPTON® grade for a particular application. The properties shown are typical properties and should not be used to establish specifications. To obtain more specific information on a particular SEPTON® grade, contact your SEPTON® representative.

Application Selector Guide

	SEPTON® Grades														
	1000 Series			2000 Series			4000 Series			8000 Series					
	1001	2002	2004	2007	2005	2006	2063	2104	4033	4044	4055	4077	8007	8004	8006
Polymer Modification															
Adhesives/Sealants/Coatings															
Wire & Cable Coatings															
Viscosity Improver															
Compatibilizer															
General Compounding															

Certain grades may be used for FDA approved applications.

Contact your SEPTON® representative for specific.



SEPTON® High Performance Thermoplastic Rubber

These are typical values and should not be used to set specifications.

Property Type	1001	2002	2004	2007	2005	2006	2063
	SEP	SEPS	SEPS	SEPS	SEPS	SEPS	SEPS
Styrene Content wt%	35	30	18	30	20	35	13
Specific Gravity	0.92	0.91	0.89	0.91	0.89	0.92	0.88
Hardness shore A	80	80	67	80	—	—	36
Tensile Property							
100% Modulus MPa		3.2	2.2	3.0	—	—	0.4
Tensile Strength MPa	2	11.2	16	16.7	—	—	10.8
Elongation %	<100	480	690	580	—	—	1200
MFR							
230°C, 2.16kg g/10min	0.1	70	5	2.4	No Flow	No Flow	7
200°C, 10kg g/10min	1	100		4	No Flow	No Flow	22
Solution Viscosity							
5wt% mPa·s					40	27	
10wt% mPa·s	70			17	1700	1220	29
15wt% mPa·s	1220	25	145	70			140
Physical Form ¹⁾	Pellet	Pellet	Pellet	Pellet	Powder	Powder	Pellet

¹⁾ Precautions should be taken in handling and storing.

Refer to the appropriate Material Safety Data sheet for further safety information.

In using SEPTON®, please confirm related law and regulations, and examine its safety and suitability for the application.

For medical and health care applications, please contact your SEPTON® representative for specific recommendations.

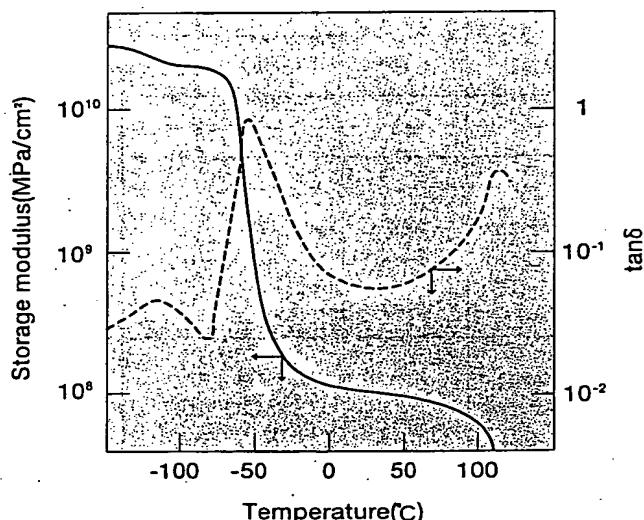
(Tested by KURARAY CO., LTD.)

2104 SEPS	4033 SEEPS	4044 SEEPS	4055 SEEPS	4077 SEEPS	8007 SEBS	8004 SEBS	8006 SEBS	8104 SEBS	Measurement Method
65	30	32	30	30	29	29	33	60	
0.98	0.91	0.91	0.91	0.91	0.91	0.91	0.92	0.97	ISO 1183
98	76	—	—	—	80	80	—	98	ISO 48
4.3	2.2	—	—	—	2.3	2.3	—	12.9	
<100	35.3	—	—	—	20.6	31.6	—	32.8	ISO 37
500	500	—	—	—	560	560	—	500	
0.4 22	<0.1 <0.1	No Flow No Flow	No Flow No Flow	No Flow No Flow	1	<0.1 <0.1	No Flow No Flow	— —	ISO 1133
23	50 390	22 460	90 5800	300	25	40	42	80	Toluene solution 30°C
Pellet	Powder	Powder	Powder	Powder	Pellet	Powder	Powder	Pellet	

SEPTON® Basic Characteristics

(Test Data from KURARAY CO., LTD.)

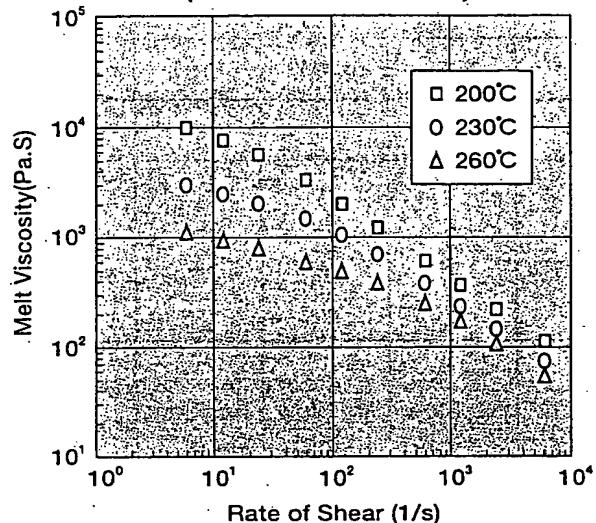
Dynamic Viscoelastic Behavior (SEPTON® 2007)



Test Conditions:

Aparatus: Dynamic Rheometer "REOVIBRON DDV-III"
Tensile mode
Heating Rate: 3°C/min
Frequency: 11Hz

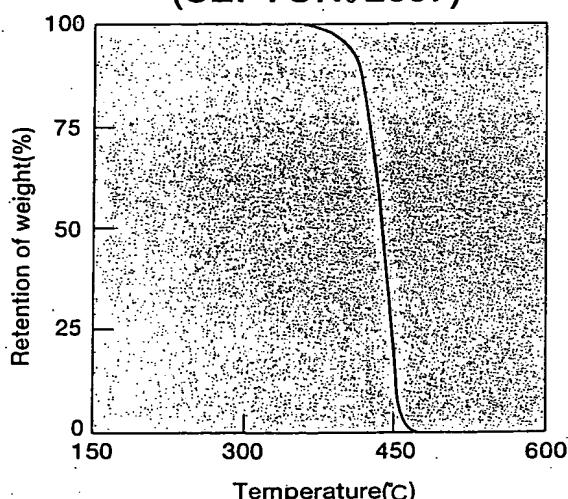
Capillary Flow Test (SEPTON® 2007)



Test Conditions:

Aparatus: Capillary Rheometer "CAPIRO GRAPH"

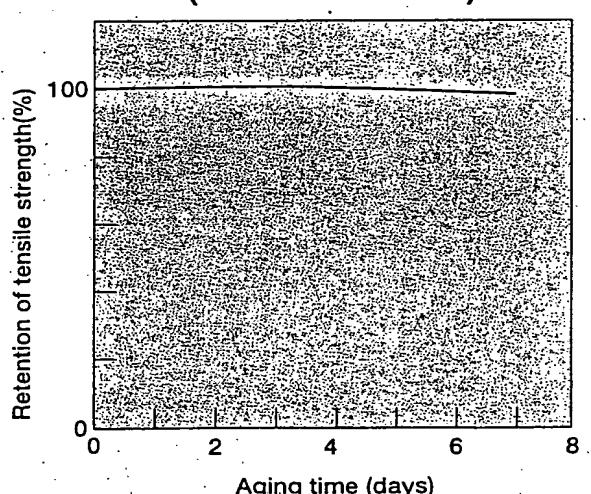
Heat Resistance (SEPTON® 2007)



Test Conditions:

Thermobalance Heat Degradation
Heating Rate: 10°C/min
Nitrogen Atmosphere

Heat Aging Resistance (SEPTON® 2007)



Test Conditions:

Geer Oven at 120°C

SEPTON® Basic Characteristics

(Test Data from KURARAY CO., LTD.)

Electrical Properties (SEPTON® 2063)

Item	Grade	2063
Dielectric Constant	5Hz	2.31
	10 ³ Hz	2.31
	10 ⁶ Hz	2.31
Dielectric Loss Tangent	5Hz	0.0002
	10 ³ Hz	0.0002
	10 ⁶ Hz	0.0008
Dielectric Breakdown Voltage	kV/mm	23.0
Volume Resistivity	Ω·cm	3.0×10 ¹⁶

Test Conditions:JIS K-6911-Dielectric Breakdown Voltage:Voltage Rising Rate =1kV/sec
Electrode 25 mm φ plate(measured in insulating oil)
Volume Resistivity:Measured 1min. after applying DC500V @20°

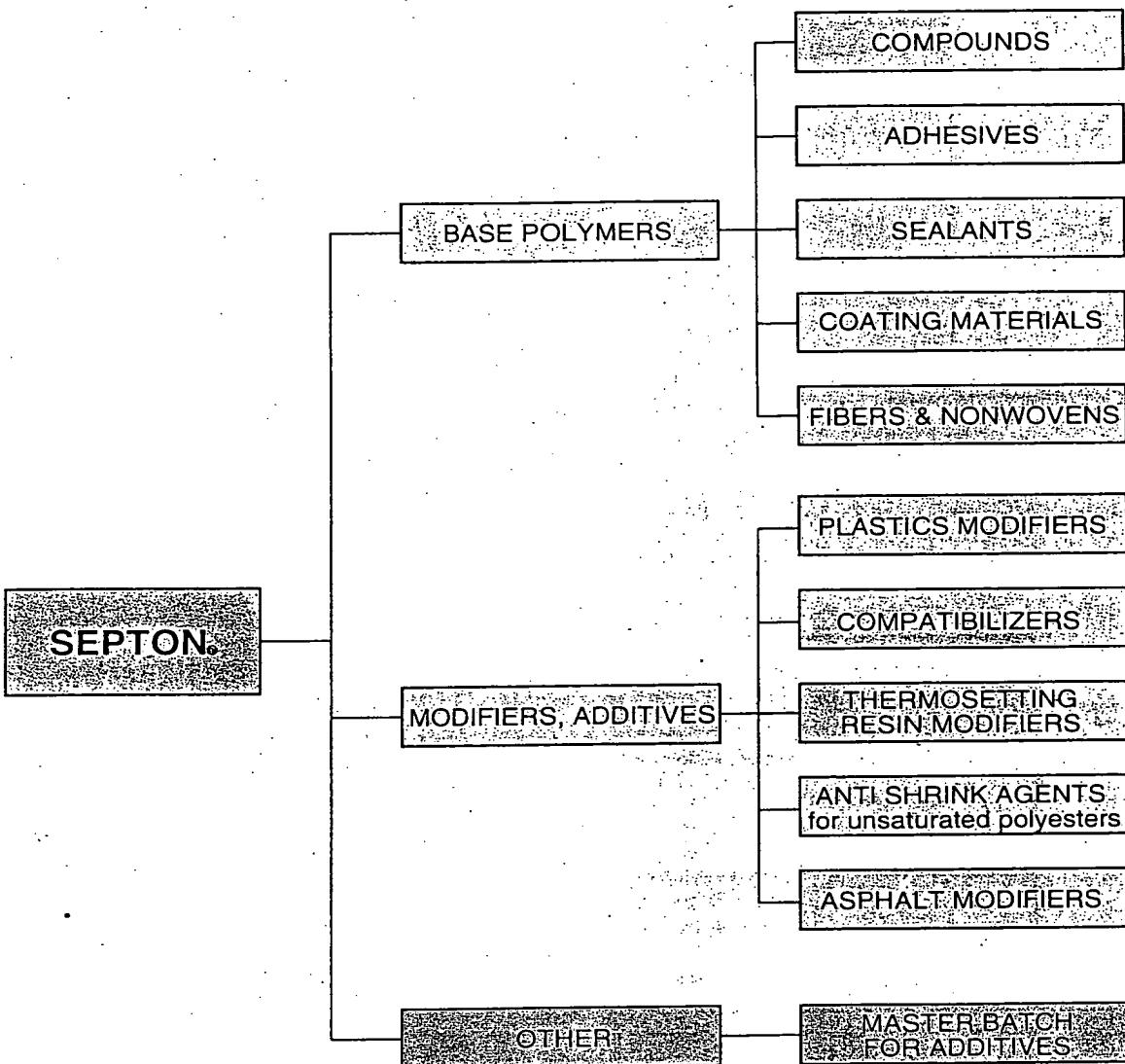
Combustion Test (SEPTON® 2002)

	Amount Formed (mg/g)	Detection Limit (mg/g)
Combustion Gas SOx(reduced to SO ₂)	not detected	1
NOx(reduced to NO ₂)	not detected	1
HCl	not detected	0.05
HCN	not detected	0.005
NH ₃	not detected	0.05
CO	1.1	0.5
CO ₂	2,900	20
Gross Calorific Value Cal/g	10,800	

Test Conditions:Combustion gas was analyzed in accordance with JIS K-7217
Gross Caloric Value:Nekken type automated gas cylinder calorimeter

SEPTON® Applications

Due to their excellent balance of properties and versatility, SEPTON® polymers are applied to a wide variety of uses as can be seen below.



The following are examples of typical formulations or polymer modification where SEPTON® polymers provide high performance at an economical cost.

SEPTON® Applications

Compounds

When blended with a polyolefin and a process oil, SEPTON® provides a soft compound that is a suitable replacement for vulcanized rubber and soft PVC.

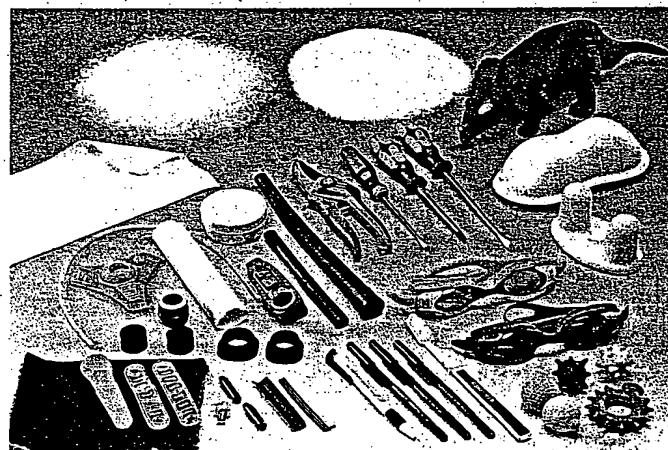
(test data from KURARAY CO., LTD.)

	1	2	3
Formulation			
SEPTON® 4055	100	100	100
Polypropylene	75	50	25
Process Oil	120	120	120
Anti Oxidant (parts by wt.)	0.3	0.3	0.3
MFR 230°C, 2.16kg g/10min.	10	2.9	0.1
Hardness JIS A	76	64	45
Mechanical Properties			
100% Modulus MPa	3.1	2.2	0.9
300% Modulus MPa	4.2	3.1	1.6
Tensile Strength MPa	15.2	10.8	7.4
Elongation %	790	790	850
Permanent Set (100% @ 10min.) %	16	10	5
Compression Set (70°C @ 22hrs) %	48	39	29

Mixing Condition:Twin Screw Extruder, 230°C, 200rpm.

(1MPa=10.20kgf/cm²)

Molding Condition: Injection Molding



Examples of practical use of SEPTON® compounds

SEPTON® Applications

Adhesives

Due to their excellent balance of properties and versatility, SEPTON® polymer are applied to a wide variety of uses as can be seen below.

SEPTON® Solubility

Poor or Non Soluble In : Ethyl Acetate, Methyl Ethylketone,
Methanol, Ethanol, Acetone, Water

Soluble : Petroleum Ether, Toluene, Benzene,
Hexane, Cyclohexane

Tackifiers Compatible with SEPTON®

Rubber Phase: Alicyclic Saturated Hydrocarbon Resins,
Hydrogenated Terpene Resins,
Petroleum Resin, Hydrogenated Rosin Resin

Hot melt Adhesives

(tested by Kuraray Co., Ltd)

	1	2	3	4
SEPTON® 2063	100	100	100	100
SEPTON® 2004	300	250	200	300
Tackifier	100	100	100	100
Paraffinic Process Oil (parts by wt.)				
Rolling Ball Tack Test	3	18	22	<2
Creep Test: Holding Power (mm)	90	104	105	>240
Slippage (mm)				6.5
Peel Test: To Stainless Steel (g/cm)	1200	1000	740	1380
To PE (g/cm)	1090	840	480	500
Melt Viscosity: 160°C (mPa·s)	3250	4280	5600	4700

TEST Conditions : Coating Thickness 30 μm

Rolling Ball Tack Test: Measured at 25°C

Creep Test: Load 1kg at 40°C, Sample Size 25mm X 25mm

Peel test: 180° Peel test Rate of Peel 300mm/min at 25°C

Melt Viscosity: Brook field viscometer

SEPTON® Applications

Plastics Modification

When blended with olefinic polymers, SEPTON® improves various properties including impact strength. SEPTON® can also act as a compatibilizer between polyolefins and polystyrenics.

Polypropylene Modification

(test data from KURARAY CO., LTD.)

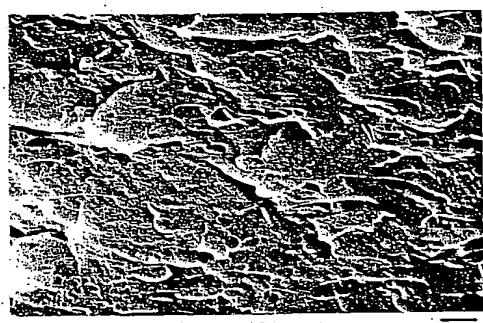
	1	2	3	4
PP (Block copolymer)	100	80	80	80
SEPTON® 2004		20		
SEPTON® 2007			20	
EPR				20
Izod Impact Strength				
25°C	(J/m)	117	614	547
-20°C	(J/m)	38.5	141	122
Flexural Modulus	(MPa)	752	572	671
Flexural Strength	(MPa)	23.3	18.3	19.3
				18.3

Compatibilizer

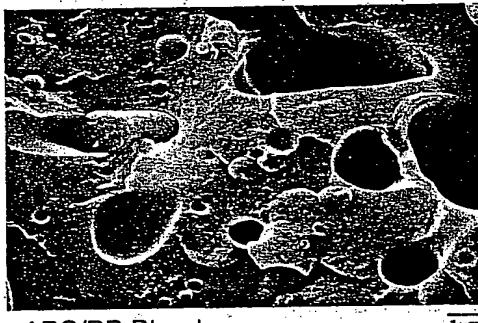
(test data from KURARAY CO., LTD.)

	1	2
ABS	70	70
PP	30	30
SEPTON® 2104	(parts by wt.)	5
Izod Impact Strength		
Notched 25°C	J/m	49
Unnotched 25°C	J/m	167
Flexural Modulus	MPa	2040
		1980

(1 MPa = 10.20 kgf/cm²)
(1 J/m = 0.102 kgf·cm/cm)



ABS/PP/SEPTON® Blend



ABS/PP Blend

Scanning Electron Micrograph(X1000)



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